UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/815,746	03/23/2001	Sining Mao	30874.101USU1	6228

23552 7590 04/29/2004

MERCHANT & GOULD PC
P.O. BOX 2903
MINNEAPOLIS, MN 55402-0903

EXAMINER	
CAO, ALLEN T	
ART UNIT	**PAPER NUMBER**
2652	10

DATE MAILED: 04/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/815,746	Applicant(s) MAO ET AL.	
	Examiner Allen T Cao	Art Unit 2652	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 February 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,11 and 15-19* is/are rejected.

7)☒ Claim(s) *5-10 and 12-14* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-3, 16 and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa et al (US. 6,538,858 B1) in view of Saito et al (US. 5,869,963).

Hasegawa et al disclose a magnetic sensor having a giant magnetoresistive sensing layer including a magnetic free layer 5 (in the Prior art of Hasegawa et al discloses that magnetic free layer is made of a ferromagnetic) ; and a hard bias layer 6 positioned and configured to maintain the free layer in a single domain state (column 21, lines 43-48) as set forth in claims 1, 16 and 18-19. Regarding claim 16, Hasegawa et al it is inherently shown that the sensor of the Hasegawa et al is builted for a magnetic disk drive as well known in the art and which a disk drive having a media(s) and a driving mechanism (see Gill).

Hasegawa et al do not disclose that the hard bias layer has a coercivity of at least 2,000 Oe (claims 1, 16 and 18-19) or 2,300 Oe (claim 2).

Saito et al disclose a magnetoresistive sensor having a hard bias layer 5 has a coercivity of 1,300 Oe.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the hard bias layer of the sensor of Hasegawa et al with a coercivity of at least 2,000 Oe (claims 1, 16 and 18-19) or 2,300 Oe (claim 2) as taught

by Saito et al. Eventhough, Saito et al only disclose 1,300 Oe, but Saito et al has shown the way of increasing the coercivity force of the hard bias layer.

The rationale is as follows: One of ordinary skill in the art would have been motivated to manufacture the hard bias layer of the sensor of Hasegawa et al with a coercivity of at least 2,000 Oe as taught by Saito et al to decrease the occurrence of Barkhausen noise in order to improve read/write characteristics of the sensor.

Regarding claim 3, Hasegawa et al disclose that the hard bias layer 317 generally has a thickness of of about 20 to 50 nm which is not more than 60nm as claimed (column 46, lines 56-57).

Hasegawa et al disclose a magnetic sensor having a giant magnetoresistive sensing layer including a magnetic free layer 5 (in the Prior art of Hasegawa et al discloses that magnetic free layer is made of a ferromagnetic) ; and a hard bias layer 6 positioned and configured to maintain the free layer in a single domain state (column 21, lines 43-48). Hasegawa et al also disclose that the thickness of the hard bias layer is preferably larger than the thickness of the free layer. However, Hasegawa et al as modified by Saito et al do not disclose that the hard bias layer having a "magnetic remnance times thickness" at least two times the value of the "saturation magnetization times thickness" of the free layer as further claimed in claim 19.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the sensor of Hasegawa et al as modified by Saito et al such that that the hard bias layer having a "magnetic remnance times thickness" at least two times the value of the "saturation magnetization times thickness" of the free layer to

provide a stronger bias magnetic field can be easily applied to the free layer, thereby easily putting the free magnetic layer into the single domain state and decreasing the occurrence of Barkhausen noise.

3. Claims 4 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa et al and Saito et al as applied to claim 1 above, and further in view of Gill (US. 6,052,263).

Hasegawa et al and Saito et al do not disclose that the hard bias layer having a seed layer and a permanent magnetic layer as set forth in claims 4 and 11.

Gill discloses a magnetic sensor having a seed layer 440 formed of Cr; a permanent magnet layer 430 formed of alloy of CoPtCr which is deposited on the seed layer 440 (both combined layers acting as a hard bias layer).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the hard bias layer of the sensor of Hasegawa et al as modified by Saito et al with seed layer and magnetic magnet layer as set forth to improve single state domain characteristics of the free layer which reduce noise and improve read/write characteristics of the sensor.

Gill only discloses that the seed layer formed of Cr and the magnetic magnet layer formed of an alloy of CoPtCr. However, Gill does not disclose that the seed layer is formed of an alloy between two elements chosen from the group consisting essentially of W, Mo, Cr, V, Nb, Ta, Ti, Hf and Zr and the permanent magnetic layer formed of an alloy of CoPt, all as set forth in claims 4 and 11.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to manufacture the seed and permanent magnetic layer of Hasegawa as modified by Saito et al and Gill with such material as set forth, supra through routine lab experimentation and optimization because it is obvious to one of ordinary skill in the art using the lab experimentation to combine known material in order to improve the quality of the seed and permanent magnet layer to reduce noise and improve read/write characteristics of the sensor.

4. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa et al.

Hasegawa et al disclose a magnetic sensor having a giant magnetoresistive sensing layer including a magnetic free layer 5 (in the Prior art of Hasegawa et al discloses that magnetic free layer is made of a ferromagnetic) ; and a hard bias layer 6 positioned and configured to maintain the free layer in a single domain state (column 21, lines 43-48). Hasegawa et al also disclose that the thickness of the hard bias layer is preferably larger than the thickness of the free layer. However, Hasegawa et al do not disclose that the hard bias layer having a "magnetic remnance times thickness" at least two times the value of the "saturation magnetization times thickness" of the free layer.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the sensor of Hasegawa et al such that that the hard bias layer having a "magnetic remnance times thickness" at least two times the value of the "saturation magnetization times thickness" of the free layer to provide a stronger bias magnetic field can be easily applied to the free layer, thereby easily putting the free

magnetic layer into the single domain state and decreasing the occurrence of Barkhausen noise.

5. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gill.

Gill discloses a giant magnetoresistive sensing layer having a top surface, a bottom surface and at least a side surface intersecting the top and bottom surfaces at an angle substantially different from 180 degress (figure 4). Gill also discloses a permanent magnetic layer 430 deposited on the seed layer 440.

Gill only discloses that the seed layer 440 formed of Cr and the magnetic magnet layer formed of an alloy of CoPtCr. However, Gill does not disclose that the seed layer is formed of an alloy between two elements chosen from the group consisting essentially of W, Mo, Cr, V, Nb, Ta, Ti, Hf and Zr.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to manufacture the seed and permanent magnetic layer of Hasegawa as modified by Saito et al and Gill with such material as set forth, supra through routine lab experimentation and optimization because it is obvious to one of ordinary skill in the art using the lab experimentation to combine known material in order to improve the quality of the seed and permanent magnet layer to reduce noise and improve read/write characteristics of the sensor.

6. Claims 5-10 and 12-14 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

7. The following is a statement of reasons for the indication of allowable subject matter: The prior art of record neither discloses nor suggests the combined limitations of claims 1 and 4 and further limitations of "the seed layer comprises TiW with 1 to 15 atomic percent W, and wherein the permanent magnetic layer comprises of CoPt as recited in claims 5 and 6. The prior art of record neither discloses nor suggests the combined limitations of claims 1 and 11 and further limitations of "the seed layer further comprises a metallic layer bonded to the alloy layer comprising the alloy, wherein the permanent magnetic is in contact with the layer comprising the alloy" as claimed in claim 12.

Response to Arguments

8. Applicant's arguments filed 2/9/04 have been fully considered but they are not persuasive.

In the "REMARKS" applicant asserts that the combination of Hasegawa and Saito is not a proper rejection because Hasegawa as modified by Saito fails to disclose or suggest a hard bias layer having a coercivity of 2,000 Oe, as required by claim 1. Further, Saito fail to provide any suggestion or disclosure that raising the coercivity of hard bias layer 5 above 1,300 would effect the Barkhausen noise in either a positive or negative direction.

Hasegawa et al has been relied upon for disclosing a magnetic sensor as set forth in claims 1, 16 and 18-19 (see above Office Action).

Saito et al disclose a magnetoresistive sensor having a hard bias layer 5 has a coercivity of 1,300 Oe.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the hard bias layer of the sensor of Hasegawa et al with a coercivity of at least 2,000 Oe (claims 1, 16 and 18-19) or 2,300 Oe (claim 2) as taught by Saito et al. Eventhough, Saito et al only disclose 1,300 Oe, but Saito et al inherently has shown the way of increasing the coercivity force of the hard bias layer (figure 11; column 14, lines 1-7; column 18, line 63 to column 9, line 21; and column 21, lines 15-22), which is discussed a laminated layer which inherently includes the hard layer 5.

Therefore, the examiner maintains that one of ordinary skill in the art would have been motivated to manufacture the hard bias layer of the sensor of Hasegawa et al with a coercivity of at least 2,000 Oe as taught by Saito et al to decrease the occurrence of Barkhausen noise in order to improve read/write characteristics of the sensor. Additionally, it is obvious to one of ordinary skill in the art at the time the invention was made to use engineering routine lab experimentation and optimization to improve the coercivity of the hard layer of Hasegawa et al as modified by Saito from 1,300 Oe to 2,000 Oe.

Applicant also asserts that:

"Hasegawa discloses a hard bias layer having a thickness greater than a thickness of the free layer. However, Hasegawa fails to disclose or suggest a hard bias layer 'having a magnetic remnance times thickness (Mrt) at least two

times the value of the saturation magnetization times thickness (Mst) of the free layer,' ...." (Remarks, page 8, lines 12-19.

Hasegawa et al has been utilized to disclose a magnetic sensor having the thickness of the hard bias layer is preferably larger than the thickness of the free layer. However, Hasegawa et al do not disclose that the hard bias layer having a "magnetic remnance times thickness" at least two times the value of the "saturation magnetization times thickness" of the free layer.

The Examiner maintains that the rejection is proper because it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the sensor of Hasegawa et al such that that the hard bias layer having a "magnetic remnance times thickness" at least two times the value of the "saturation magnetization times thickness" of the free layer to provide a stronger bias magnetic field can be easily applied to the free layer, thereby easily putting the free magnetic layer into the single domain state and decreasing the occurrence of Barkhausen noise.

Applicant further asserts that Gill is not a proper rejection because "Gill discloses ...." (Remarks, page 8, line 22 to page 9, line 10).

Gill discloses a giant magnetoresistive sensing layer having a top surface, a bottom surface and at least a side surface intersecting the top and bottom surfaces at an angle substantially different from 180 degress (figure 4). Gill also discloses a permanent magnetic layer 430 deposited on the seed layer 440.

Gill only discloses that the seed layer 440 formed of Cr and the magnetic magnet layer formed of an alloy of CoPtCr. However, Gill does not disclose that the seed layer

is formed of an alloy between two elements chosen from the group consisting essentially of W, Mo, Cr, V, Nb, Ta, Ti, Hf and Zr.

The Examiner maintains that the rejection is proper because it would have been obvious to one of ordinary skill in the art at the time the invention was made to manufacture the seed and permanent magnetic layer of Hasegawa as modified by Saito et al and Gill with such material as set forth, supra through routine lab experimentation and optimization because it is obvious to one of ordinary skill in the art using the lab experimentation to combine known material in order to improve the quality of the seed and permanent magnet layer to reduce noise and improve read/write characteristics of the sensor.

Regarding claims 18 and 19, the rejection have been changed as in the above paragraph No. 2 due to Applicant's amendment.

9. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allen T Cao whose telephone number is (703) 305-3796. The examiner can normally be reached on Mon - Thurs (7:30 - 6:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hoa T Nguyen can be reached on (703) 305-9687. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-4750.

Allen Cao
Primary Examiner

AC
October 31, 2003